J. Perinat. Med.
6 (1978) 274

Atrial tachy-arrhythmias associated with massive edema in the newborn

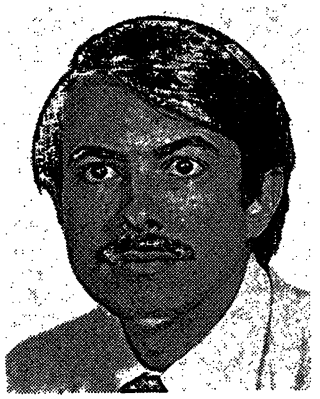
Richard L. Schreiner, Roger A. Hurwitz, Charles R. Rosenfeld, William Miller

Department of Pediatrics, Indiana University Medical Center, The James Whitcomb Riley Hospital for Children, Indianapolis, Indiana

Department of Pediatrics, University of Texas Health Science Center, Dallas, Texas

Anasarca or massive edema of the newborn (hydrops fetalis) and atrial tachy-arrhythmias are frequently seen in the neonatal period; however, an association between the two is not well recognized. This paper reports three infants less than one week of age who demonstrated such an association. We have also reviewed the literature of paroxysmal supraventricular tachycardia (PST) and atrial flutter (AF) in infants less than one week of age **to evaluate the relationship between the occurrence of tachy-arrhythmia and edema.**

Curriculum vitae



RICHARD L. SCHREINER, *B.S., M.D., was born in 1945. He graduated from St. Louis University and Washington University School of Medicine in St. Louis, Missouri. He received his Pediatric training at Washington University and his Perinatal training at Washington University and University of Colorado. He is presently an Assistant Professor of Pediatrics in the Division of Neonatal-Perinatal Medicine at Indiana University School of Medicine. He combines clinical responsibilities on the Newborn Intensive Care Unit and research work, which is mainly centered around fetal metabolism.*

1.1 Case 1

The patient was the product of an 18 year-old gravida 1 para 0, whose estimated date of confinement was unknown. She had no known illnesses; however she gained 29 kg during the pregnancy, the last month of which she had edema, proteinuria, and hypertension. Her total serum protein was 4.7 gm/100 ml and albumin 2.0 gm/100 ml. Monitoring begun one hour before delivery showed a fetal heart rate of 60–160/minute. Following the spontaneous onset of labor a Cesarean section was performed because of a large infant in the breech presentation. The infant was a severely cyanotic and hydropic 4,000 gm male (Fig. 1). Because of the edema, the heart was difficult to auscultate but the rate was thought to be 200–250/minute and irregular. Because of the cyanosis and hypoventilation (pO_2 48 mm Hg, pCO_2 102 mm Hg, pH 6.92, FiO_2 .60) the infant was intubated and placed on an infant respirator. The systolic blood pressure was 85 mm Hg. At six hours of age the heart rate was 250/minute on the cardiac monitor but spontaneously converted to a sinus rhythm with a rate of 120/minute prior to obtaining an EKG. Other laboratory data included: calcium 9.9 mg%, total bilirubin 1.6 mg%, BUN 16 mg%, normal electrolytes, mother's blood type O Rh^+, infant's blood type A Rh^+ and direct COOMB's negative and a normal urinalysis. Anasarca,

0300-5577/78/0006-0274$02.00

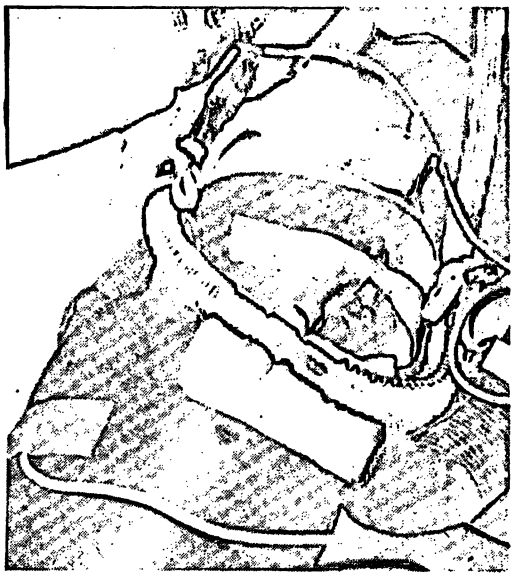


Fig. 1. Severe edema in Case 1. No pitting above right nipple.

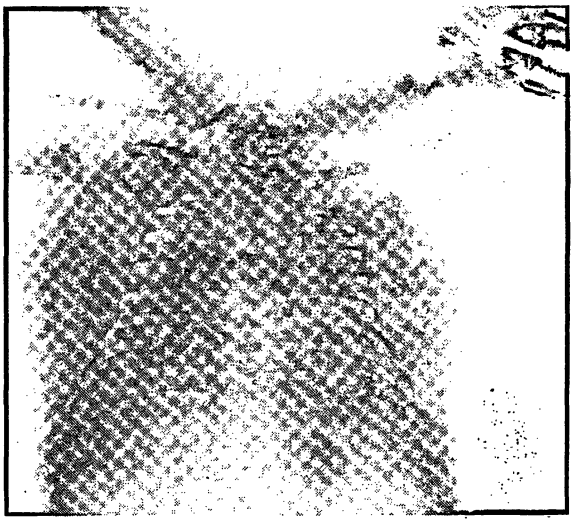


Fig. 2. Massive edema, pleural effusion but normal heart size in Case 1.

ascites, bilateral pleural effusions, and a normal heart size were present on the roentgenogram (Fig. 2). The placenta weighed 1,100 gm and there were three cord vessels. Microscopically the placenta had edematous villi, increased syncytial knots with degeneration of the trophoblast, and areas of true infarction. No choriangiomas were present. The infant received furosemide and digitalis in addition to general supportive care. At 24 hours of age he developed second degree heart block and at three days of age AF. At five days of age he was in sinus rhythm with Wolff-Parkinson-White and this pattern persisted until discharge. He lost 2,000 gm over the first four days and was extubated without difficulty on the fifth day. During the next week he developed multiple episodes of PST. At nineteen days he required a tracheostomy due to severe upper airway obstruction secondary to subglottic stenosis. The infant slowly gained weight and was discharged at ten weeks. Initially, he did well at home but was found dead in bed at twelve weeks of age. There was no history of upper respiratory infection or respiratory distress immediately preceding his death. Autopsy at another hospital showed a clear tracheostomy tube, no gross anomalies, and no evidence of pneumonia. The only positive findings were multiple pleural petechiae and mild left ventricular hypertrophy.

1.2 Case 2

The infant was a 4,100 gm male, delivered to a 21 year-old gravida 2 para 1 after an uncomplicated pregnancy. Polyhydramnios was noted at delivery. The APGAR score was seven at both one and five minutes. Because of suspected ascites the infant was transferred to Riley Children's Hospital. On admission the patient had mild respiratory distress, no heart murmur, and the pulse was regularly irregular at 160/minute. His abdomen was distended and a fluid wave was detectable. The liver was palpable 4 cm below the right costal border and edema of the lower extremities was noted. Laboratory data included: total bilirubin 6.2 mg% with a direct fraction of 0.8 mg%, mother's blood type Rh^-, infant's blood type A Rh^+ and direct COOMB's negative. The pH, pCO_2 and pO_2 were normal (FiO_2 .30). Moderate to severe cardiomegaly was evident on chest roentgenogram. Atrial flutter with intermittent 2:1 and 3:1 atrioventricular block was present on EKG. The patient was given digoxin. Cardiac catheterization showed no anatomic abnormality. He lost 600 gm over the first two days. The patient converted to normal sinus rhythm on the second hospital day and had continued in normal sinus rhythm with a normal cardiac examination when last seen at $2\frac{1}{2}$ years of age. Digoxin was discontinued at fourteen months of age.

1.3 Case 3

The patient was a 3,200 gm white male born to a 26 year-old gravida 3 para 2 mother with A Rh^+ blood. The pregnancy was uncomplicated; however the fetal heart rate was noted to be abnormally increased during the third trimester. Delivery was difficult because of marked ascites and edema of the trunk and lower extremities. The heart rate was 240/minute and regular. Endotracheal intubation and resuscitation were required immediately. The infant was transferred to Children's Medical Center of Dallas at one hour of age. On physical examination the infant was in severe respiratory distress with generalized edema. Blood pressure was 60 mm Hg. He had diminished breath sounds bilaterally and no heart murmurs. Pulses were symmetrical in all four extremities. The liver edge was palpable 3 cm below the right costal margin and the spleen was 2 cm below the left costal margin. Laboratory data included: blood type O Rh^+, direct COOMB's negative, sodium 128 mEq/L, total bilirubin 1.1 mg%, total protein 3.0 gm%, pO_2 131 mm Hg, pCO_2 85.9 mm Hg, pH 6.89 (FiO_2 1.0). Bilateral pleural effusions with normal heart size and pulmonary vascular markings were present on chest roentgenograms. The infant received intravenous fluids, albumin, packed red blood cells, ventilatory support, bilateral thoracenteses and antibiotics. Throughout the first day the electrocardiogram demonstrated PST with a rate of 250/minute. At 22 hours of age cardioversion resulted in a normal sinus rhythm and the infant was started on digoxin. At 28 hours of age PST recurred. Repeat cardioversion resulted in restoration of normal sinus rhythm. The infant lost 550 grams over the first four days. Total bilirubin increased to 24.6 mg% (7.4 mg% direct) on the third day and an exchange transfusion was performed. Cultures of the blood and pleural and peritoneal fluids were sterile. On the sixth hospital day prolonged and repeated episodes of ventricular fibrillation occurred, responding to intravenous propranolol and quinidine. On the twelfth day, diminished spontaneous motor activity, recurrent major motor seizures, and episodes of bradycardia were noted. Cardiac arrest occurred on the thirteenth day and resuscitation was unsuccessful.

At autopsy no specific abnormalities of the cardiac conduction system were seen and there was not any evidence of myocarditis. Sections of the liver showed areas of total lobular necrosis with fibrosis.

2 Discussion

While massive edema or anasarca of the fetus and newborn usually results from isoimmunization due to Rh incompatibility between the mother and fetus, **approximately 10–20% of cases of hydrops fetalis in this country are related to non-immunologic etiologies** including fetal-maternal hemorrhage, twin transfusion syndrome, multiple births, achondroplasia, cystic adenomatoid malformation of the lung, pulmonary lymphangiectasia, multiple congenital anomalies, maternal diabetes mellitus, dysmaturity, placental chorioangiomas, congenital infections, alpha-thalassemia, neuroblastomatosis, congenital renal disease, umbilical vein thrombosis, chorionic vein thrombosis, toxemia of pregnancy, pulmonary hypoplasia, severe maternal anemia, myocarditis, and severe congenital heart disease [7].

The association of hydrops fetalis with congenital heart disease has been reported with subaortic stenosis and endocardial fibroelastosis [16], premature closure of the foramen ovale [18], or ductus arteriosus [2], atrioventricular valve insufficiency with endocardial fibroelastosis [17], EBSTEIN's malformation [17], myocarditis [3], arteriovenous fistula [8, 20], hypoplastic left heart syndrome [15], and cardiac neoplasm [24]. In a review of 200 consecutive cases of major congenital heart disease BEISCHER [4] found five cases of nonimmunologic hydrops. Neither congenital heart disease nor other abnormalities were found in the three cases reported in this paper.

PST is the most common tachycardia in infants and children. The estimated frequency of 1 in 25,000 probably represents a gross underestimate since many cases are asymptomatic and undiagnosed. Usually found in patients with otherwise normal hearts, the disorder may be associated with infections, myocarditis, cardiac surgery, cardiac catheterization, congenital heart disease, hyperthyroidism, and most commonly Wolff-Parkinson-White syndrome. Most attacks occur before three months of age. Atrial flutter is much less common

in infants but the symptomatology is similar to that of PST [13].

As early as 1953, ANDERSON [1], in a review of thirteen infants with PST commented on the large weight of the patients but did not describe the presence of either edema or anasarca. In RADFORD's [14] recent report of twelve cases of congenital PST the birthweight was generally large for gestational age. Presumably the relatively large birthweights are directly related to fluid retention from heart failure.

Among the reported cases of congenital PST or AF, eleven were associated with anasarca (Tab. I). While these eleven cases and our three suggest that a causal relationship may exist between these two findings, this occurrence is obviously not consistent since most patients with congenital PST or AF, as noted above, were not reported to be edematous. PST and AF have frequently been demonstrated in utero with fetal electrocardiography [11, 19, 12, 22] with the infant having neither distress nor evidence of edema in the neonatal period. Why some infants develop hydrops while others do not is perplexing. It is possible that the duration of the tachycardia and the absolute heart rate in utero are important variables, but they are difficult to evaluate over long periods of time.

The signs and symptoms of PST and AF occurring postnatally have been attributed to congestive heart failure. The edema in such cases may result from an increase in heart rate which leads to a decrease in diastolic filling and cardiac output, an increase in venous and capillary hydrostatic pressure, an increase in renin, angiotensin and aldosterone, and subsequent increase in sodium and water retention. Many cases of PST have, however, been diagnosed in utero months prior to delivery with the infants described as normal at the time of birth. It is possible that these cases represent intermittent rather than sustained PST. **Moreover, two of the six cases with PST and anasarca recently reported and two of our cases had a normal heart size on roentgenogram.** Hypoxia and shock with increased vascular permeability have also been suggested as a cause of the edema [9, 6]. In the case of PST, chronic hypoxia in utero would likely be caused by congestive heart failure secondary to the arrhythmia or by placental insufficiency following the development of placenta edema.

Though the prognosis of infants with PST is usually quite good, three (WEDEMEYER [10], Cases 1, 3) of the fourteen cases with PST anasarca have died. Two expired at three and six months of age of unknown etiologies. **It would appear that the concurrent occurrence of PST and edema significantly increases mortality.**

The problem of the management of the obstetrical patient complicated by fetal PST is a difficult one. The use of ultrasound to diagnose early edema

Tab. I. Clinical and laboratory data of twelve patients.

	Hydramnios	Fetal arrhythmia	Birth weight (gm)	EKG	Heart size
Kesson [14]	+	+	4,100	PST	N
Silber [21]	+	+	3,370	PST	N
van der Horst [23]	–	–	4,800	AF	↑
Hedvall [10]	–	+	4,010	PST	↑
Cowan [5]	–	–	4,000	PST	↑
Wedemeyer [24]	–	–	2,700	AF	↑
Radford [19]	–	–	4,200	PST	↑
Radford [19]	–	–	2,460	AF	↑
Radford [19]	–	–	3,100	AF	↑
Radford [19]	–	+	3,460	AF	↑
Radford [19]	+	+	3,390	AF	↑
Case 1	+	+	4,000	AF	N
Case 2	+	–	4,110	AF	↑
Case 3	–	–	3,220	PST	N

↑ Increased + Present
N Normal – Data not available

might be appropriate. In these instances, when the amniotic fluid suggests mature lungs early delivery might be indicated. However, it is important to emphasize that most infants who have beenreported with documented intermittent fetal tachycardia have been normal at delivery. Therefore caution in advocating early intervention is appropriate.

Summary

Anasarca or massive edema of the newborn and atrial tachyarrhythmias are frequently seen in the neonatal period. This paper reports three infants less than one week of age who demonstrated both conditions. Approximately 10–20% of cases of hydrops fetalis in this country are related to non-immunologic etiologies. The association of hydrops fetalis with congenital heart disease has been reported for a large number of specific cardiac malformations.

Among the reported cases of congenital paroxysmal supraventricular tachycardia (PST) or atrial flutter (AF) we were able to find 11 in the literature that were associated with anasarca. However, most infants with in utero PST and AF are born with neither respiratory distress nor evidence of edema. The signs and symptoms of PST and AF occurring postnatally have been attributed to congestive heart failure. However, two of the six cases with PST and anasarca recently reported had a normal heart size of roentgenogram.

Though the prognosis of patients with PST is usually quite good, three of the fourteen cases with PST and anasarca have died. It would appear that the concurrence of PST and edema significantly increases mortality. The problem of management of the obstetrical patient complicated by fetal PST is a difficult one. It is important to emphasize that most infants who have been reported with documented intermittent fetal tachycardia have been normal at delivery. Therefore, caution in advocating early intervention seems appropriate.

Keywords: Arrhythmias, congenital heart disease, congestive heart failure, hydrops fetalis, tachycardia.

Zusammenfassung

Vorhof-Tachy-Arrhythmie mit schwerem Ödem des Neugeborenen

Anasarka oder schweres Ödem bei den Neugeborenen und Vorhof-Tachy-Arrhythmie werden in der neonatalen Periode häufig beobachtet. Diese Studie berichtet von drei Kindern, die weniger als eine Woche alt waren und die beide Zustände vorwiesen. Hier werden annähernd 10–20% der Fälle mit fetalem Hydrops mit nichtimmunologischen Ursachen in Verbindung gebracht. Von der Kombination des fetalen Hydrops mit angeborenem Herzfehler ist in einer großen Anzahl von spezifischen Herzmißbildungen berichtet worden.

Wir fanden in der Literatur unter den berichteten Fällen von angeborenem paroxysmaler supraventrikulärer Tachykardie (PST) oder Vorhofflattern (AF) elf Fälle, die mit Anasarka verbunden waren. Die meisten Kinder mit angeborener PST und AF werden weder mit Atmungsschwierigkeiten noch mit einem Hinweis auf Ödeme geboren. Die Zeichen und Symptome von PST und AF, die sich nach der Geburt zeigen, sind der Stauungsinsuffizienz des Herzens zuzuschreiben. Zwei von berichteten sechs Fällen mit PST und Ödemen hatten einen normalen Herzumfang im Röntgenbild.

Obgleich die Prognose von Patienten mit PST gewöhnlich gut ist, sind drei von vierzehn Fällen mit PST und Anasarka gestorben. Es scheint, daß das Zusammenwirken von PST und Ödemen die Sterblichkeit wesentlich fördert. Das Problem der Behandlung der Patientinnen während der Geburt, bei denen eine fetale PST festgestellt wird, ist schwierig. Es ist wichtig, nachdrücklich zu betonen, daß die meisten Kinder mit dokumentierter intermittierender fetaler Tachykardie z. Zt. der Geburt normal gewesen sind. Daher ist Vorsicht bei frühen klinischen Konsequenzen geboten.

Schlüsselwörter: Arrhythmie, Herzfehler, Hydrops (fetaler), Stauungsinsuffizien, Tachykardie.

Résumé

Les tachy-arythmies atriales associées avec l.oedème massif chéz le nouveau-né

L'anasarque ou oedème massif du nouveau-né ainsi que les tachy-arythmies atriales ne sont pas rares dans la période néonatale. Le présent article concerne trois bébés âgées de moins d'une semaine et qui ont manifesté les deux troubles précités. 10–20% environ des cas d'hydrops fetalis dans ce pays sont en corrélation avec des étiologies nonimmunologiques. L'association de l'hydrops fetalis avec les troubles cardiaques congénitaux a été observée dans un grand nombre de malformations cardiaques spécifiques.

Parmi les cas rapportés de PST congénital ou de flutter atrial, nous avons pu trouver dans la littérature 11 cas

d'association avec l'anasarque. Néanmoins, la plupart des bébés avec PST et AF (atrial flutter) in utero naquirent sans asphyxie périnatale ni évidence d'oedème. Les signes et symptômes de PST et AF observés après la naissance ont été attribués à une défaillance cardiaque congestive. Toutefois, deux des six cas de PST et anasarque relatés récemment ont montré sur le roentgenogramme une taille normale du coeur.
Bien que le pronostic des patients avec PST soit très bon généralement, on enregistra le décès de trois des quatorze cas de PST et anasarque. Il semble donc que l'association de PST et d'oedème accroisse de façon significative le taux de mortalité. Le traitement obstétrique de la parturiente avec complication de PST foetal reste difficile. Il importe de souligner à cet égard que la plupart des bébés avec tachycardie foetale intermittente observée et dont le cas a été rapporté dans la littérature médicale se sont montrés normaux à l'accouchement. Aussi semble-t-on être en droit de recommander une intervention précoce à titre de précaution.

Mots-clés: Arythmies, défaillance cardiaque congestive, hydrops fetalis, tachycardie, trouble cardiaque congénital.

Acknowledgement: Supported by American Heart Association, Indiana Affiliate, Inc.

Bibliography

[1] ANDERSON, R. C., F. H. ADAMS: Congenital paroxysmal tachycardia. Report of a case and review of the literature. J. Pediatr. 43 (1953) 668
[2] ARCHILLA, R. A., O. B. THILENIUS, K. RANNINGER: Congestive heart failure from suspected ductal closure in utero. J. Pediatr. 75 (1969) 74
[3] BATES, JR., H. R.: Coxsackie virus B3 calcific pancarditis and hydrops fetalis. Amer. J. Obstet. Gynec. 106 (1970) 629
[4] BEISCHER, N. A., D. W. FORTUNE, J. MACAFEE: Nonimmunologic hydrops fetalis and congenital abnormalities. Obstet. Gynec. 38 (1971) 86
[5] COWAN, R. H., A. L. WALDO, H. B. HARRIS, G. CASSADY, Y. W. BRANS: Neonatal paroxysmal supraventricular tachycardia with hydrops. Pediatrics 55 (1975) 428
[6] DI PASQUALE, E. L., A. A. SCHILLER: Effect of hypoxemia on edema formation in perfused isolated rat hind limb. Proc. Soc. Exp. Biol. Med. 78 (1951) 567
[7] DRISCOLL, S. G.: Hydrops fetalis. N. Engl. J. Med. 275 (1966) 1432
[8] GOMEX, M. R., C. F. WHITTEN, A. NOLKE, J. BERNSTEIN, J. S. MEYER: Aneurysmal malformation of the great vein of Galen causing heart failure in early infancy. Pediatrics 31 (1963) 400
[9] GRUNEWALD, P., H. W. MAYBERGER: Hydrops of the fetus: A manifestation of shock. Amer. J. Med. Sci. 220 (1950) 12
[10] HEDVALL, G.: Case report: Congenital paroxysmal tachycardia – a report of three cases. Acta Pediat. Scand. 62 (1973) 550
[11] HERIN, P., C. THOREN: Congenital arrhythmias with supraventricular tachycardia in the perinatal period. Acta Obstet. Gynec. Scand. 52 (1973) 381
[12] HOCHBERG, H. M., P. J. POPPERS, M. E. D. GEORGE: Fetal paroxysmal supraventricular tachycardia recorded by intrauterine scalp electrocardiography. J. Perinat. Med. 4 (1976) 51
[13] HURWITZ, R. A.: Cardiac arrhythmias in infants and children. Curr. Prob. Pediatr. 3 (1973) 6
[14] KESSON, C. W.: Fetal paroxysmal auricular tachycardia. Brit. Heart J. 20 (1958) 552
[15] LEAKE, R. D., B. STRIMLING, G. C. EMMANOUILIDES: Intrauterine cardiac failure with hydrops fetalis. Clin. Pediatr. 12 (1963) 649
[16] MACAFEE, C. A. J., D. W. FORTUNE, N. A. BEISCHER: Nonimmunological hydrops fetalis. J. Obstet. Gynec. 77 (1970) 226
[17] MOLLER, J. H., R. P. LYNCH, J. E. EDWARDS: Fetal cardiac failure resulting from congenital anomalies of the heart. J. Pediatr. 68 (1966) 699
[18] NAEYE, R. L., W. A. BLANC: Prenatal narrowing or closure of the foramen ovale. Circulation 30 (1964) 736
[19] RADFORD, D., T. IZUKAWA, R. D. ROWE: Congenital paroxysmal atrial tachycardia. Arch. Dis. Childh. 51 (1976) 613
[20] SHINOHARA, Y., M. SEKI: Dystocia due to fetal ascites. Report of a case with congenital malformations of liver and lung. Bull. N.Y. Acad. Med. 37 (1961) 136
[21] SILBER, D. L., R. E. DURNIN: Intrauterine atrial tachycardia. Amer. J. Dis. Childh. 117 (1969) 722
[22] TUXEN, P., E. L. KAPLAN, K. UELAND: Intrauterine paroxysmal atrial tachycardia. Amer. J. Obstet. Gynec. 109 (1971) 958
[23] VAN DER HORST, R. L.: Congenital atrial flutter and cardiac failure presenting as hydrops foetalis at birth. S. A. Med. J. 44 (1970) 1037
[24] WEDEMEYER, A. L., V. BREITFELD: Cardiac neoplasm, tachyarrhythmia, and anasarca in an infant. Amer. J. Dis. Childh. 129 (1975) 738

Received November 1, 1977. Accepted December 23, 1977

Richard L. Schreiner, M.D.
Assistant Professor of Pediatrics
Division of Neonatal-Perinatal Medicine
Indiana University School of Medicine
The James Whitcomb Riley Hospital for Children
1100 West Michigan Street
Indianapolis, Indiana 46202